Bioprospecting & Benefits-Sharing

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The Issue

Researchers who study material obtained under a Yellowstone National Park research permit are now required to enter into benefits-sharing agreements with the National Park Service before using their research results for any commercial purpose.

Definitions

Bioprospecting: The search for useful scientific information from genetic or biochemical resources. It does not require large-scale resource consumption typical of extractive industries associated with the term "prospecting," such as logging and mining.

Benefits-sharing: An agreement between researchers, their institutions, and the National Park Service that returns benefits to the parks when results of research have potential for commercial development.

Extremophile: A microorganism living in extreme conditions such as heat and acid, and that cannot survive without these conditions.

Thermophile: Heat-loving extremophile.

Background

In 1966, Dr. Thomas Brock discovered the thermophile, *Thermus aquaticus*, in a Yellowstone hot spring and successfully grew it in the laboratory. His discovery has contributed to the scientific revolution in DNA research.

Dr. Brock discusses his discovery in Yellowstone.

The next milestone in the revolution occurred in 1985, when the polymerase chain reaction (PCR) was invented. PCR is an artificial way to do something that living things do every day—replicate DNA. PCR allows scientists to make billions of copies of a piece of DNA in a few hours.

An enzyme discovered in *T. aquaticus*—called Taq polymerase—made PCR one of the most exciting inventions of the 20th century. Because Taq polymerase comes from a thermophile, it can withstand the heat of the PCR process without breaking down like ordinary polymerase enzymes. The laboratory version of this enzyme made DNA studies practical and affordable, which led to now-familiar processes such as DNA fingerprinting, DNA medical diagnoses, DNA-based studies of nature, and genetic engineering.

Controversy

As with all NPS research specimens, the Yellowstone microbes and DNA collected in the park remain in federal ownership and are never sold. Only research results, such as information and insight gained during research on park specimens, may be commercialized—not the specimens themselves. Federal law authorizes the National Park Service (NPS) to enter into benefits-sharing agreements that provide parks a reasonable share of profits when park-based research yields something of commercial value.

The invention of the polymerase chain reaction (PCR) earned enormous profits for the patent owners and Diversa Corporation, which produced and sold gene testing kits that included the Taq enzyme. However, Yellowstone received no portion of these profits because it did not have a benefits-sharing agreement in place with Diversa.

To improve this situation, Yellowstone became the first U.S. national park to enter into a benefits-sharing Cooperative Research and Development Agreement (CRADA). The CRADA stipulated that Diversa would pay Yellowstone $100,000 over five years and a royalty based on any sales revenues related to results from research in the park. (Diversa has since merged with another company to form Verenium Corporation.)

Shortly after the CRADA was signed in 1997, opponents sued the NPS in federal court to stop the agreement. They argued that the policy put into play a new commercial activity and was illegal and inappropriate in national parks. In 1999, the judge ordered the NPS to prepare an environmental analysis of the potential impacts of benefits-sharing agreements and suspended the CRADA pending completion of the analysis. In 2000, the court dismissed the remainder of the case, ruling the CRADA: 1) was consistent with the NPS mission of resource conservation; 2) that bioprospecting did not constitute a consumptive use; 3) that bioprospecting did not represent a "sale or commercial use" of park resources; and 4) Yellowstone fell within the definition of a federal laboratory and appropriately implemented the CRADA.

Status

NPS has finished a Final Environmental Impact Statement that examined the potential impacts of benefits-sharing agreements. Yellowstone expects to enter into a few benefits-sharing agreements soon.

Ongoing Research

Yellowstone's high-temperature habitats support one of Earth's greatest concentrations of extremophilic biodiversity; researchers estimate more than 99 percent of the species in Yellowstone's hydrothermal features have yet to be identified.

Annually, approximately 40 research studies are under way in Yellowstone to identify and understand its extremophiles.

These and other studies have discovered that Yellowstone's extremophiles contain thousands of uncommon, heat-stable proteins and enzymes that can withstand harsh manufacturing processes. Research on these extremophiles has led to advances in producing ethanol, treating agricultural food waste, bioremediating chlorinated hydrocarbons, recovering oil, biobleaching paper pulp, improving animal feed, increasing juice yield from fruits, improving detergents, and a host of other processes.

For More Information

parkplanning.nps.gov: Select "Washington Office," then click on benefits-sharing.

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